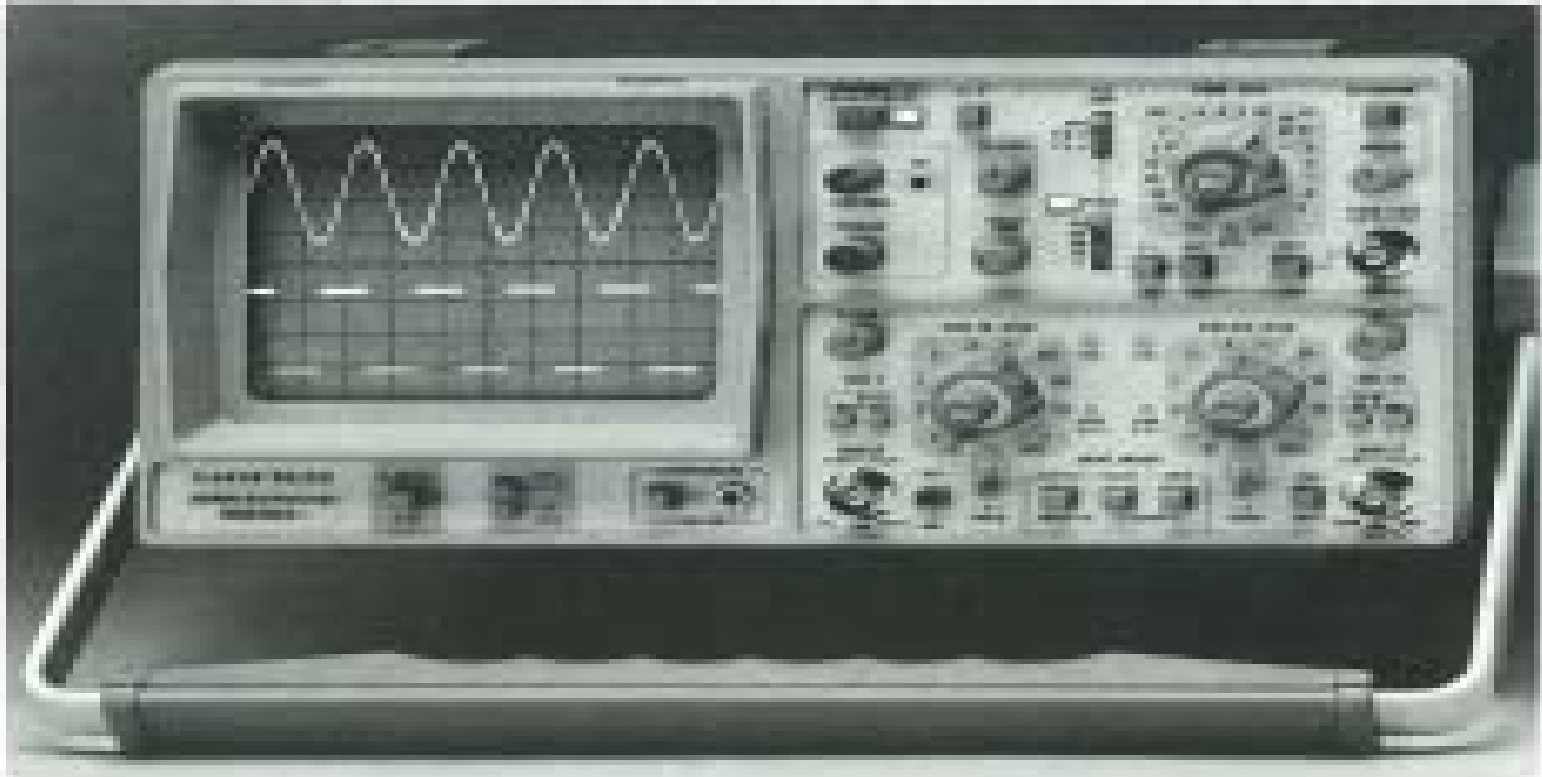


Electronics



Hameg HM 203-7



20 MHz Standard Oscilloscope

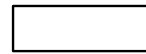
Agilent U2701A & U2761A



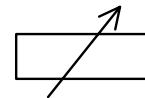
Components

- Resistor [Ohm] Ω
 - Kilo=1000 Ω : 1K Ω , 10K Ω , 56K Ω
 - Mega = 1 million Ω : 1M Ω , 4,7M Ω , 12M Ω

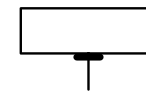
Resistor



Variable resistor

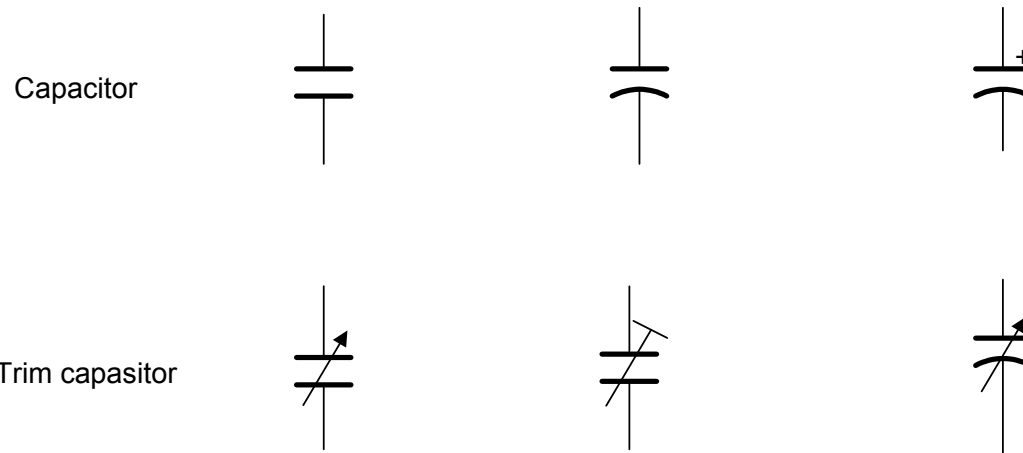


Potentiometer



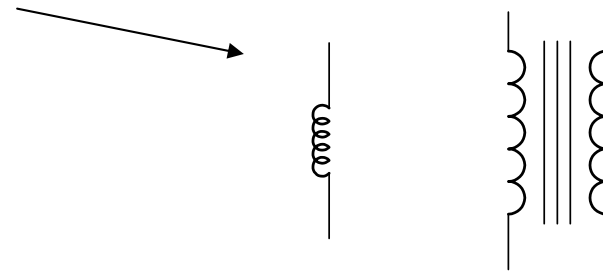
Components

- Capacitors
 - Many types!!!
 - Farah: pF 10^{-12} , nF (nano) 10^{-9} , mF (micro) 10^{-6} , (milli) μF 10^{-3} , F (very big capacitor)

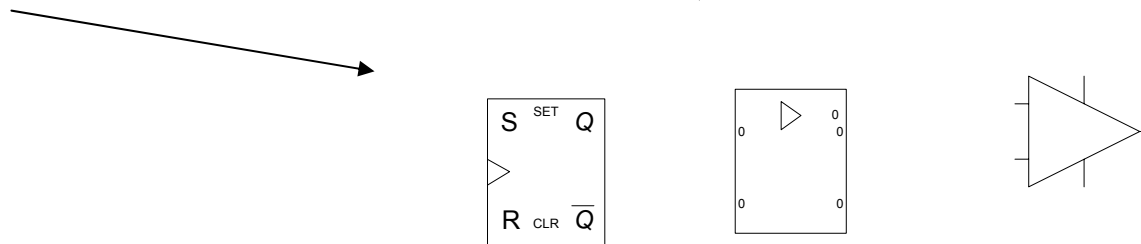


Components

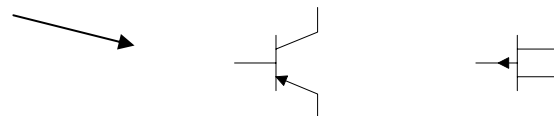
- Inductor?



- IC?



- Transistor?

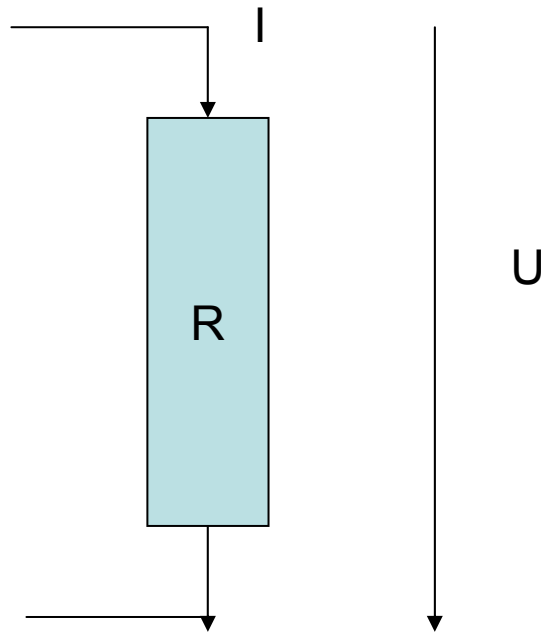


- Diodes?



Math

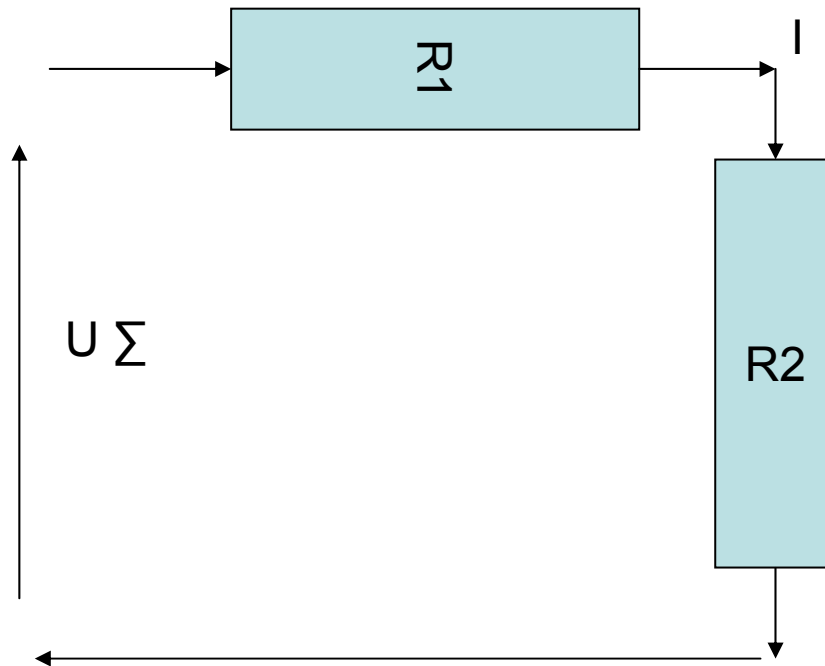
- $U = I * R$



$$U = 12V$$
$$I = 1mA$$
$$R = ?$$

OHM

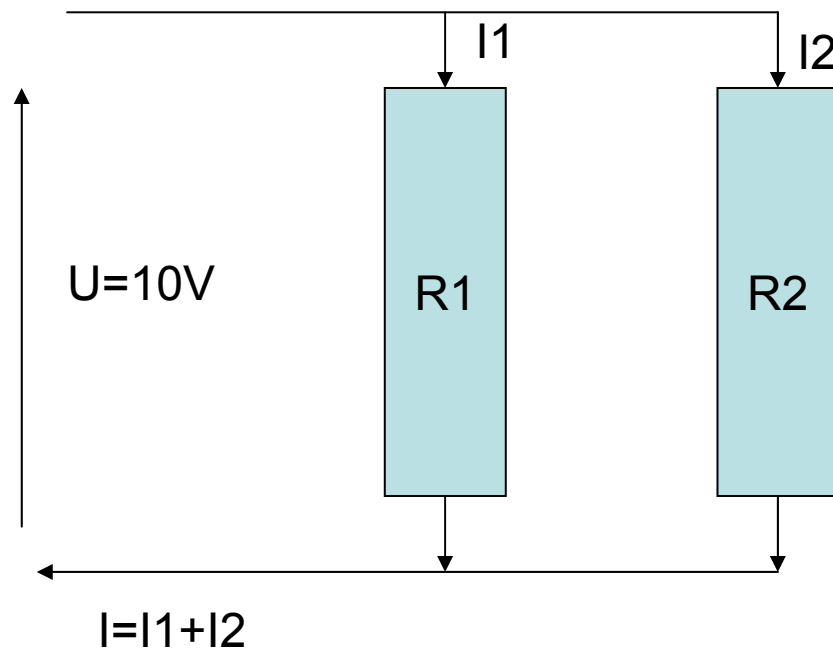
- Serial



$I=1\text{mA}$
 $R1=1\text{K } \Omega$
 $R2=2\text{K } \Omega$
 $U(R1)=?$
 $U(R2)=?$
 $U_{\Sigma}=?$

OHM

- Paralell



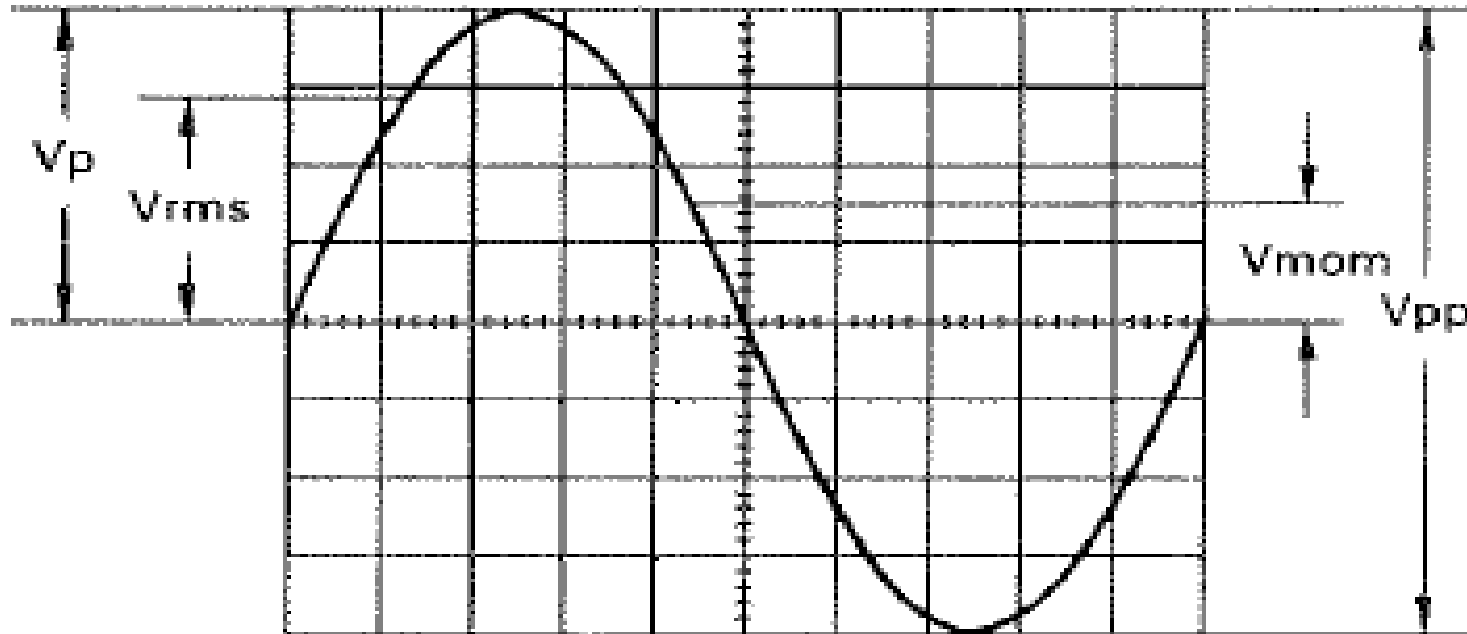
$$R1=1K$$
$$R2=2K$$
$$U=10V$$

$$I=U/(R1*R2/R1+R2)$$
$$I1=U/R1$$
$$I2=U/R2$$
$$I=I1+I2$$

AC/DC

funkgen1

AC

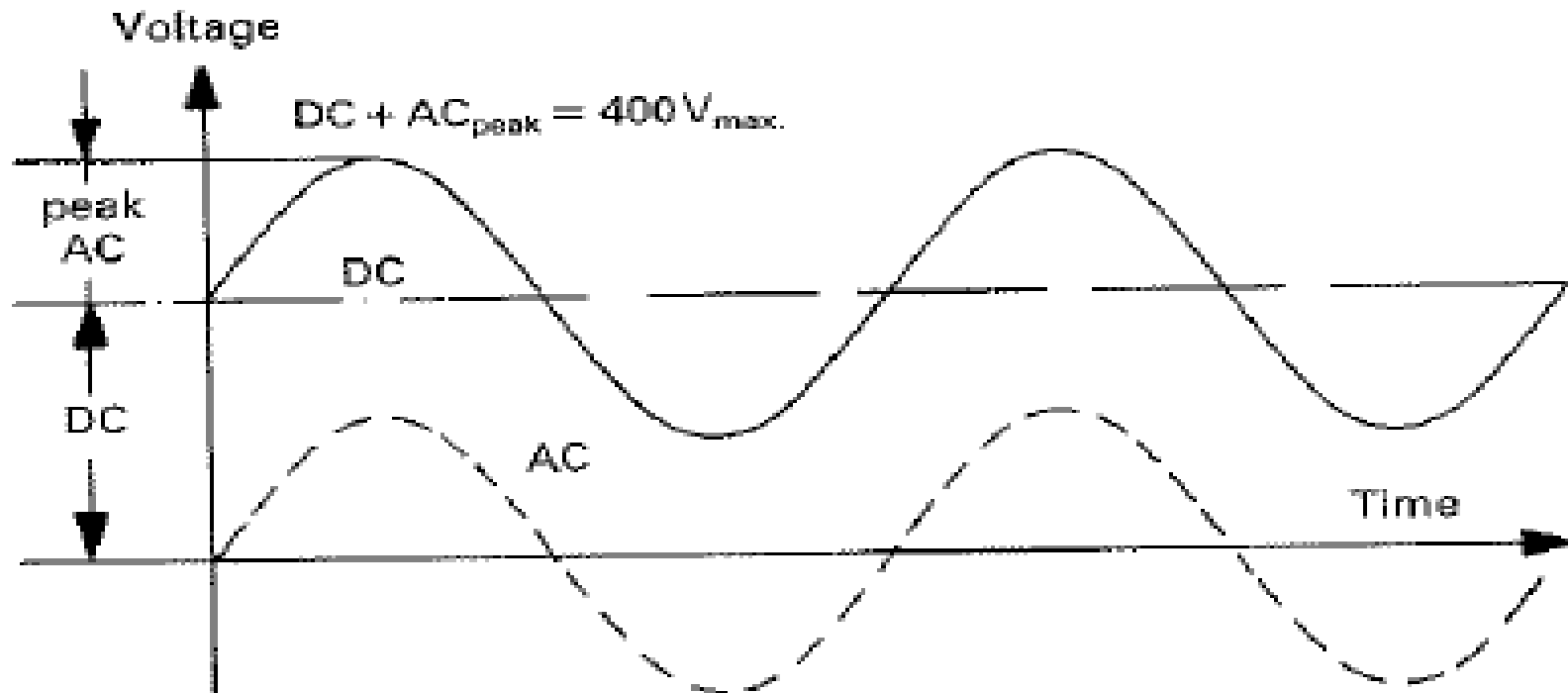


Voltage values of a sine curve

V_{rms} = effective value; V_p = simple peak or crest value;

V_{pp} = peak-to-peak value; V_{mom} = momentary value.

DC+AC



Total value of input voltage

The dotted line shows a voltage alternating at zero volt level. When superimposed a DC level, the addition of the positive peak and the DC voltage results in the max. voltage ($DC + AC_{peak}$).

Time

With the designations

L = displayed wave **length in div.** of one period,

T = **time in seconds** for one period,

F = recurrence **frequency in Hz** of the signal,

T_c = **time coefficient in s/div.** on timebase switch and
the relation **F = 1/T**, the following equations can be stated:

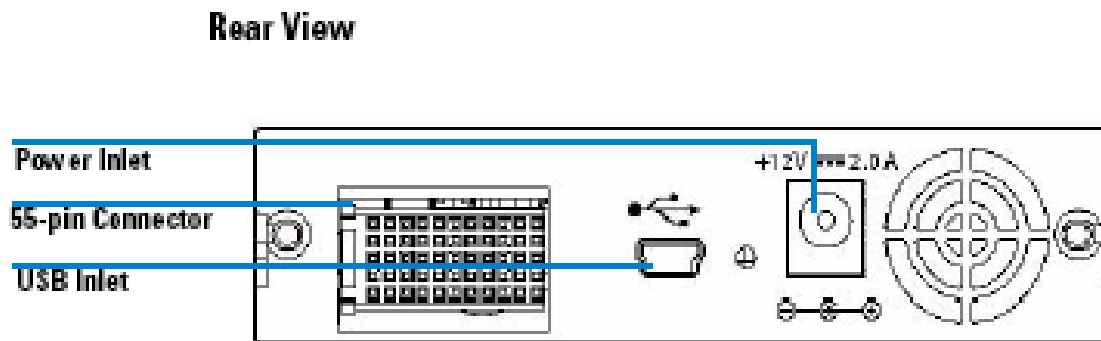
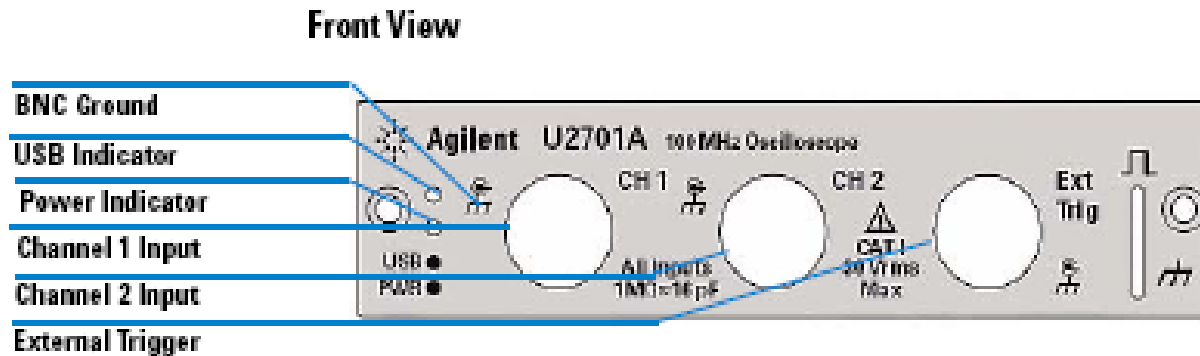
$$T = L \cdot T_c \qquad L = \frac{T}{T_c} \qquad T_c = \frac{T}{L}$$

$$F = \frac{1}{L \cdot T_c} \qquad L = \frac{1}{F \cdot T_c} \qquad T_c = \frac{1}{L \cdot F}$$

With depressed X-MAG. x10 pushbutton the T_c value must be divided by 10.

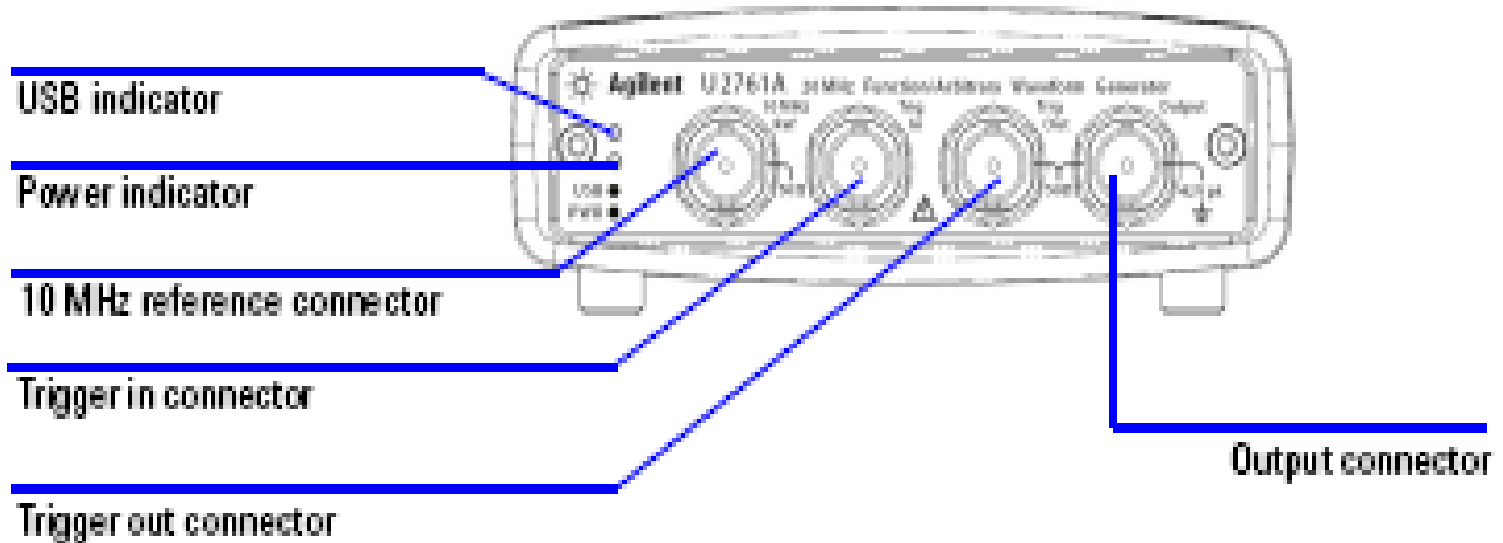
Agilent scope U2701A & U2761A

- Demonstration!!!
- Remember max 300V on the probes!!!



Agilent U2761A Generator

Front View



Hameg scope

20 MHz Standard Oscilloscope

2 Channels, max. 1 mV/div. sensitivity; Component Tester

Timebase: 0,1 s/div. to 20 ns/div.; Variable Holdoff; Alternate Triggering;

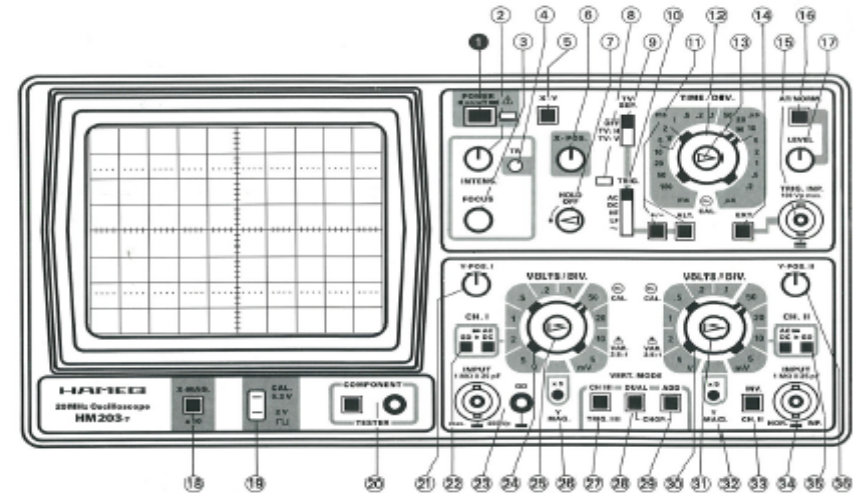
Triggering: DC-40 MHz; TV Sync Separator; Trigger LED



Hameg scope

Front Panel Elements HM203-7 (Brief Description – Front View)

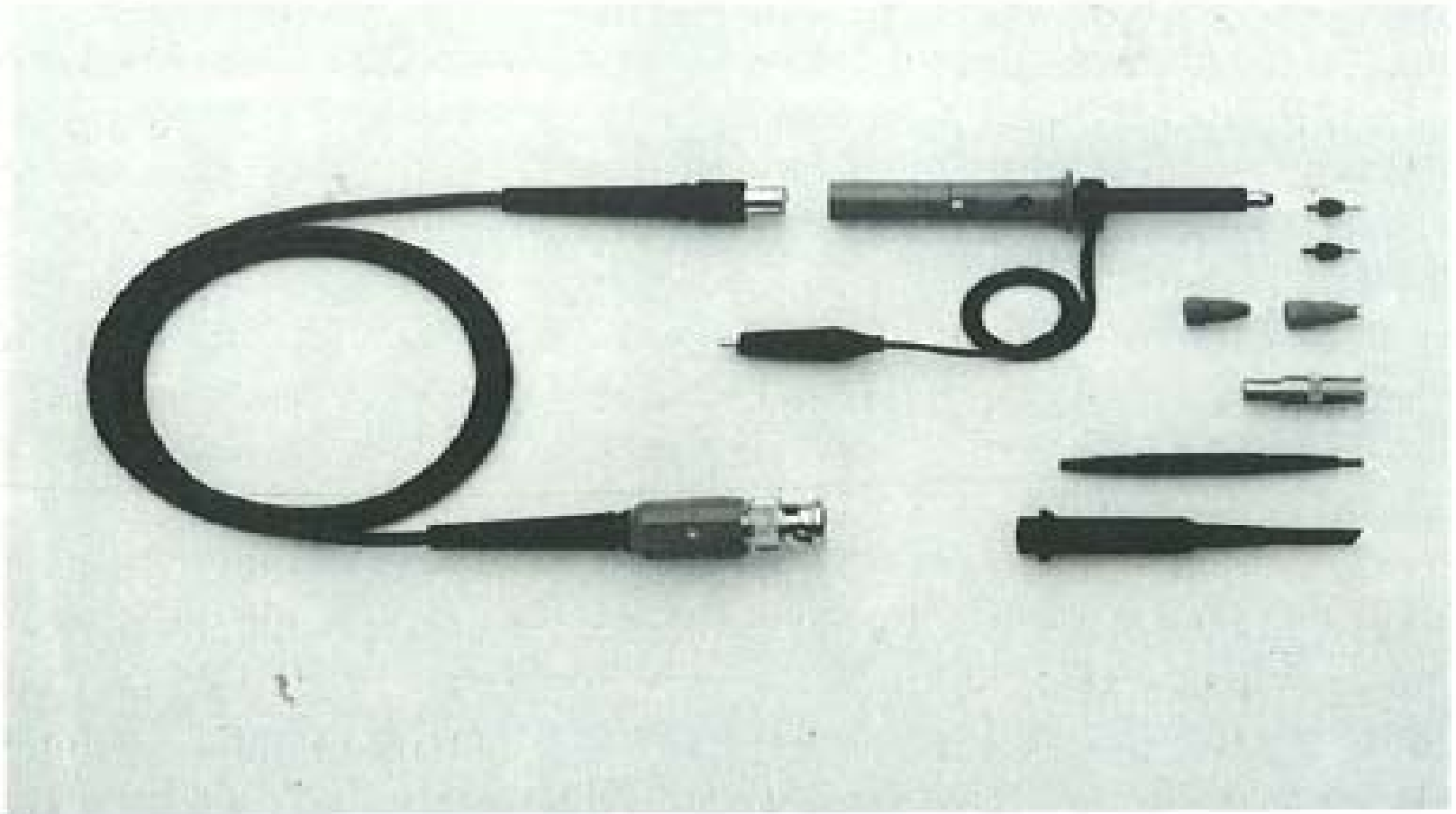
Element	Function	Element	Function
➊ POWER on/off (pushbutton + LED)	Turns scope on and off. LED indicates operating condition.	➋ COMPONENT TESTER (pushbutton switch and 4 mm jack)	Button depressed: CT in operation. 2-terminal measurement: component under test to CT jack and ground jack.
➌ INTENS. (knob)	Intensity control for trace brightness.	➍ Y-POS. I (knob)	Controls vertical position of CH. I display.
➍ FOCUS (knob)	Focus control for trace sharpness.	➎ AC-DC-GD (pushbutton switches)	Selects input coupling of the CH. I Vertical Amplifier. AC/DC depressed: direct coupling; AC/DC released: Signal is capacitively coupled (DC is blocked). GD depressed: Signal is disconnected, amplifier input is grounded.
➏ TR (pot)	Trace rotation. To align trace with horizontal graticule line. Compensates influence of earth's magnetic field.	➐ INPUT (CH. II) (BNC-connector) GD (4 mm socket)	CH. II signal input. Input impedance 1MΩ // 25 pF. Separate ground jack.
➑ X-Y (pushbutton switch)	Selects X-Y operation, stops sweep. Attention! Phosphor burn-in without X signal.	➒ VOLTS/DIV. (rotary switch)	CH. I input attenuator. Selects input sensitivity in mV/div. or V/div. in 1-2-5 sequence.
➒ X-POS. (knob)	Controls horizontal position of trace.	➓ VAR. GAIN (center knob)	Continuously variable gain between the calibrated settings of the VOLTS/DIV switch. Decreases sensitivity 1:2.5. Cal. position: cw.
➓ HOLD OFF (knob)	Controls holdoff time between sweeps. Normal position = full ccw.	➑ Y MAG. x5 (pushbutton switch)	When depressed, increasing of Y-sensitivity 5 fold (max. 1 mV/cm).
➔ TRIG. (LED)	LED lights, if sweep is triggered.	➒ CH. I/II-TRIG. I/II (pushbutton switch)	Button released: CH. I only and internal triggering from CH. I. Button depressed: CH. II only and internal trig. from CH. II. In DUAL and ADD mode: Button selects internal trigger signal.
➕ TV SEP. (lever switch)	TV Sync Separator OFF = Normal operation. TV: H = Line or horizontal frequency. TV: V = Frame or vertical frequency.	➓ DUAL (pushbutton switch)	Button released: One channel only. Button depressed: CH. I and CH. II in alternate mode. DUAL and ADD buttons depressed: CH. I and CH. II in chopped mode.
➔ TRIG. AC-DC-HF-LF-~ (lever switch)	Trigger selector AC: 10 Hz to 10 MHz. DC: DC to 10 MHz. HF: 1.5 Hz to 40 MHz. LF: DC to 50 kHz. ~: Internal line triggering.	➓ ADD (pushbutton switch)	ADD button depressed only: Algebraic addition in combination with INV. CH. II button.
➕ +/– (pushbutton switch)	Selects the slope of the trigger signal. + = rising edge; – = falling edge.	➓ VOLTS/DIV. (rotary switch)	CH. II input attenuator. Selects input sensitivity in mV/div. or V/div. in 1-2-5 sequence.
➕ ALT. (pushbutton switch)	Triggering alternates between CH. I and CH. II (Dual Channel Mode only).	➓ VAR. GAIN (center knob)	Continuously variable gain for CH. II. Specifications like ➑.
➔ TIME/DIV. (rotary switch)	Selects timebase speeds from 0.2 μs/div. to 0.1 s/div.	➑ Y MAG. x5 (pushbutton switch)	When depressed, increasing of Y-sensitivity 5 fold (max. 1 mV/cm).
➓ Variable (center knob)	Timebase variable control. Decreases timebase sweep speed 1:2.5. Cal. position = full clockwise.	➒ INV. CH. II (pushbutton switch)	Inversion of CH. II display. In combination with ADD button ➑ = algebraic addition. In X-Y mode inoperative.
➔ EXT. (pushbutton switch)	Button released = internal triggering. Button depressed = external triggering, trigger signal via TRIG. INP. ➑.	➓ INPUT CH. II (BNC-connector)	CH. II signal input and input for horizontal deflection in X-Y mode.
➓ TRIG. INP. (BNC-connector)	Input for external trigger signal, if button ➑ is depressed.	➎ AC-DC-GD (pushbutton switches)	Selects input coupling of the CH. II Vertical Amplifier. (See ➎).
➓ AT/NORM. (pushbutton switch)	Button released = autom. triggering, trace visible without input signal. Button depressed = normal triggering with LEVEL ➑ adjustment, trace invisible without signal.	➑ Y-POS. II (knob)	Controls vertical position of CH. II display. In X-Y mode inoperative.
➓ LEVEL (knob)	10 adjust TRIGGER POINT, if AT/NORM. ➑ button is depressed.		
➓ X-MAG. x10 (pushbutton switch)	10:1 expansion in the X direction. Max. resolution 20 m/div.		
➓ CALIBRATOR 0.2V-2V (eyelets)	Calibrator output for probes 10:1 = 0.2 V _{pp} , 100:1 = 2 V _{pp} (TLI).		



Hameg Scope

- Demonstration!!!

Hameg scope



Time/div- frequency

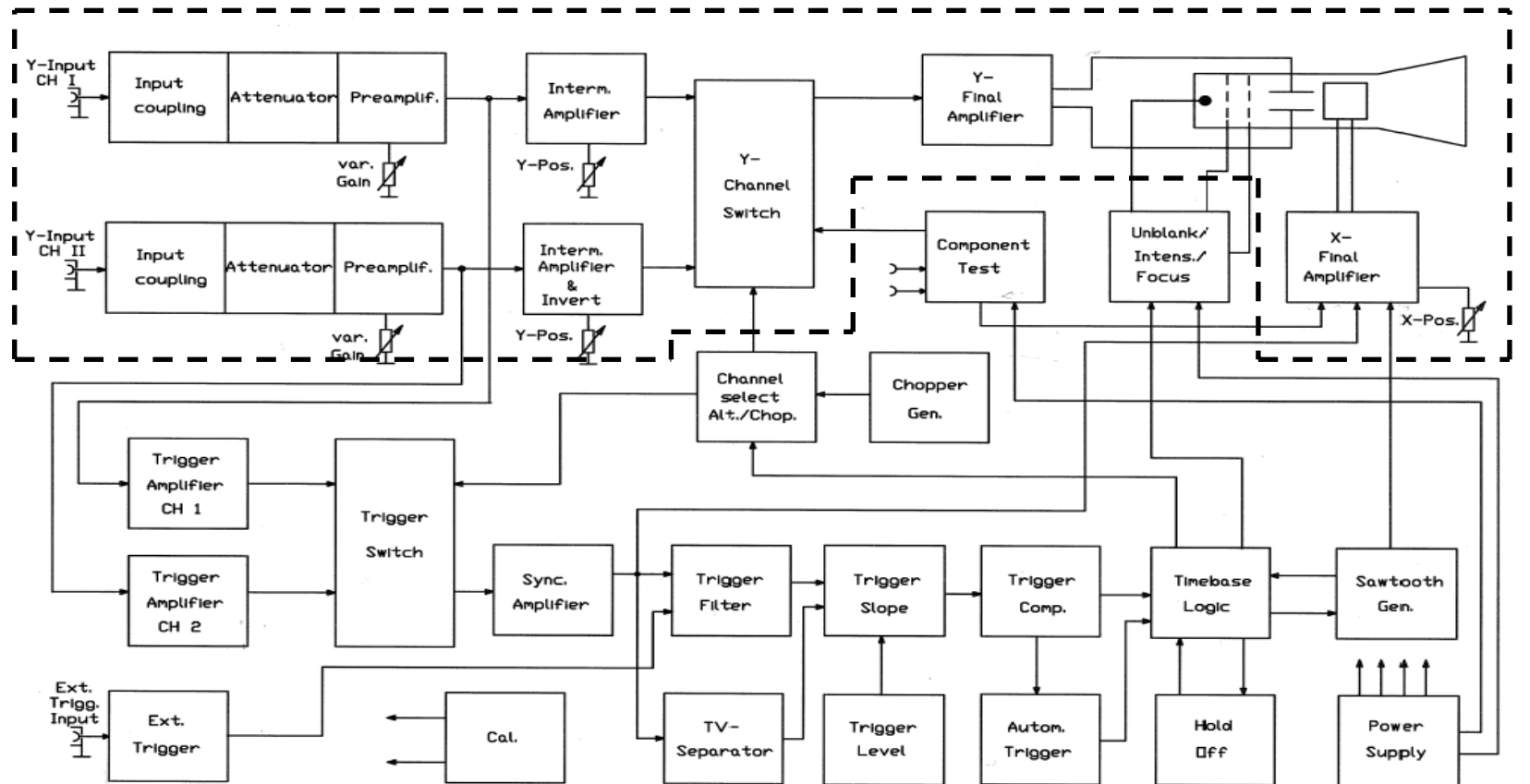
100	ms/div.	—	10	Hz	0.1	ms/div.	—	10	kHz
50	ms/div.	—	20	Hz	50	μs/div.	—	20	kHz
20	ms/div.	—	50	Hz	20	μs/div.	—	50	kHz
10	ms/div.	—	100	Hz	10	μs/div.	—	100	kHz
5	ms/div.	—	200	Hz	5	μs/div.	—	200	kHz
2	ms/div.	—	500	Hz	2	μs/div.	—	500	kHz
1	ms/div.	—	1	kHz	1	μs/div.	—	1	MHz
0.5	ms/div.	—	2	kHz	0.5	μs/div.	—	2	MHz
0.2	ms/div.	—	5	kHz	0.2	μs/div.	—	5	MHz



What part are the main obj?

Blockschaltbild / Block Diagram

HM 203-7





Components

03-0101-2007

Bezeichnung der Bauteile

Die elektrischen Bauteile sind so gekennzeichnet, daß die erste Nummer mit der Baugruppen-Nummer übereinstimmt:

- 0.** **Chassis**
Y-Input, ext. Triggeringang, Gerätestecker, Netzstecker, Netztransformatoren usw.
- 1.** **EY-Board I-III**
Empfängerteil, Y-Vorverstärker (Kanal I + II), GD-ADDC-Schalter
- 2.** **X/Y-Board**
Y-Zweischichtenverstärker, Kanalumschaltungs-Flip-Flop, Dead-Channel-Schaltung, Chopper-Generator, Triggerverstärker, Medienantriebsversorgung, Testleiste, X-Erdeverstärker, Y-Erdeverstärker, Component-Tester
- 3.** **TB-Board**
Trigger-Schaltung, Zeitbasis, Hold-off-Schaltung, Halbleitung, TV-Sync.-Sep., Potentiometer für Strahlrichtung, Hochvolt-Stromversorgung, Testleiste
- 7.** **SD-Board**
Potentiometer für horizontale Strahlflüge, Power LED, Potentiometer für Hold-off, Potentiometer für Helligkeit und Fokus
- 8.** **CRT-Board**
CRT-Fassung

HM203-1

Electrical components on certain parts of the HM203-1 are marked such that the first numeral is on:

- 0.** **Chassis**
Y-input, Trig.-ext. input, Appliance inlet, Power switch, Power transformer
- 1.** **EY-Board I-III**
Receiver and Pre-amplifier (Channel I + II), GD-ADDC switches
- 2.** **X/Y-Board**
Y-Intermediate amplifier, Channel selection flip-flop, Y-Gate driver stages, Chopper generator, Trig. and ext. Trigger amplifier, Trig. gate-driver stages, Lx-Power, Check-point strip, Component tester, X-Final amplifier, Y-Final amplifier
- 3.** **TB-Board**
Trigger circuit, Timebase circuit, Unblanking circuit, Hold-off circuit, TV sync. separator, Trace focus pot., High voltage power supply, check strip
- 7.** **SD-Board**
X-pos. pot., Power LED, Hold-off potentiometer, Intensity and Focus potentiometer
- 8.** **CRT-Board**
CRT socket

Identification of electrical Components

Farbmarkierung der Anschlußdrähte / Color-Abbreviations for insulated wire

bl = schwarz / black	gr = gelb / yellow	gr = grau / grey
br = braun / brown	gn = grün / green	wh = weiß / white
rd = rot / red	bl = blau / blue	tra = transparent / transparent
or = orange / orange	vl = violett / violet	gr/y = grün-gelb / green-yellow stripe

Anschlußfolge der Transistoren Terminals of Transistors	BC 160 C BC 160 D BF 414 BF 500	BF 100 BF 311 BF 440 BF 500	BF 422 BF 423	BC 160 B BF 160 B40	BF 200 B 1	BC 160 C FD 160 2 N 3000 TC 200 2N 2008 A TC 160	U 100	BF 450 BF 470 BO 207 BU 400 PUG 340	U 2000 TDA 2008 1 = Input 2 = Output 3 = Output	FET 401	BF 100 Code 9A Code 9B Code 9C Code 9D
Anzahl von Anoden Number of anodes	1	1	1	1	1	1	1	1	1	1	1
Anzahl von Kathoden Top view	1	1	1	1	1	1	1	1	1	1	1

Abkürzungen u. Symbole / Abbreviations and Symbols

AL	Gerätestecker	/	Appliance inlet
C	Kondensator	/	Capacitor
TC...	Testpunkt / Testleiste	/	Check point/strip strip
CH...	Steckverbinder	/	Connector
D...	Brückengleichrichter	/	Bridge rectifier
D...	Diode	/	Diode
D...	Leuchtdiode	/	Light emitting diode
F...	Sicherung	/	Fuse
IC...	Integr. Schaltung	/	Integrated circuit
L...	Spule, Drossel	/	Inductor, Coil
P...	Stecker	/	Plug
SP...	Lotlöse	/	Solder
R...	Widerstand	/	Resistor
S...	Schalter	/	Switch
T...	Transistor	/	Transistor
TR...	Transformatoren	/	Transformer
VC...	Vorstromkondensator	/	Variable capacitor
W...	Dräht	/	Wire
D...	Zwennode	/	Z-Node

⊗	Modellabhängig	/	Dependent on model
⊗	Komponente (Wert abhängige) kommt ohne Pin auf	/	Component (value depends on CRT type)
⊗	Bauteil bei Bedarf	/	Component when required
⊗	Kühlkörper/Thermokopplung	/	Heat sink/thermocoupling

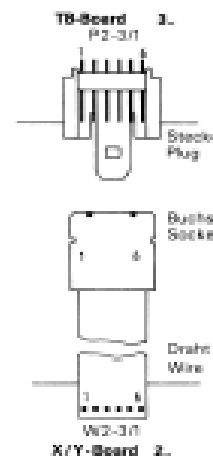
Achtung - Hinweise d. Handbuchs berücksichtigen
Attention - Refer to manual

Gefahr - Hochspannung / Danger - High voltage

Schutzleiter - Erdgeschalt. Protective-grounded (earth) terminal

Testleisten / Check strips

XY-Board		TB-Board	
10	NC	10	carh.
9	+150V	9	NC
8	NC	8	-1000V
7	GND	7	NC
6	NC	6	NC
5	+12V	5	NC
4	NC	4	GND
3	+5V	3	NC
2	NC	2	ST-W
1	-12V	1	NC



Beispiel Kabelverbindung: P2-3/1-⊗ bzw. W2-3/1-⊗

- P = Flachkabelstecker (auf Board...)
- W = Flachkabelverbindung: eine Seite verlötet, andere Seite Buchsenleiste
- 2-3 = Verbindung zwischen Board 2 und Board 3
- 1 = 1. Flachkabelverbindung zwischen Board 2 und 3
- ⊗ = Drahtnummer des Flachkabels

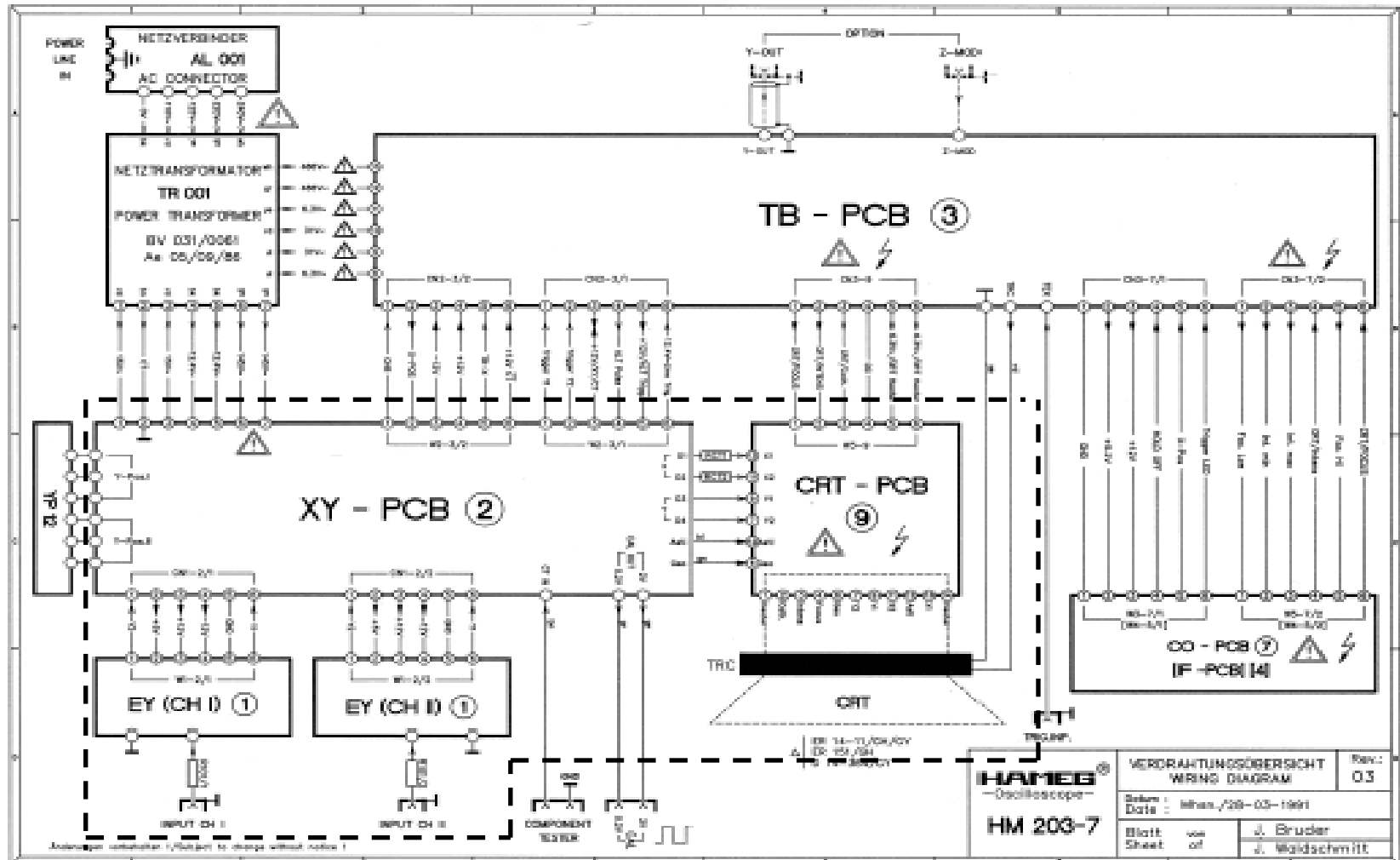
Example, cable connection: P2-3/1-⊗ or W2-3/1-⊗ respectively

- P = Flat cable plug (soldered on board...)
- W = Flat cable wiring (direct soldered on board with socket (movable))
- 2-3 = Connection between Board 2 and Board 3
- 1 = First flat cable connection between Board 2 and 3
- ⊗ = Serial number of the wire (in the flat cable)

Widerstand- / Resistor identification

	Widerstand / Resistor: 0,6 W, 1 (25%, T ₁ = 50-10 ³ °K, metal film
	Widerstand / Resistor: 0,25W, 0,5%, T ₁ = 50-10 ³ °K, metal film
	Hochvolt Widerstand / High voltage resistor: 1,8kV-, metal film
	Hochvolt Widerstand / High voltage resistor: 3,5kV-, metal film

PCB boards

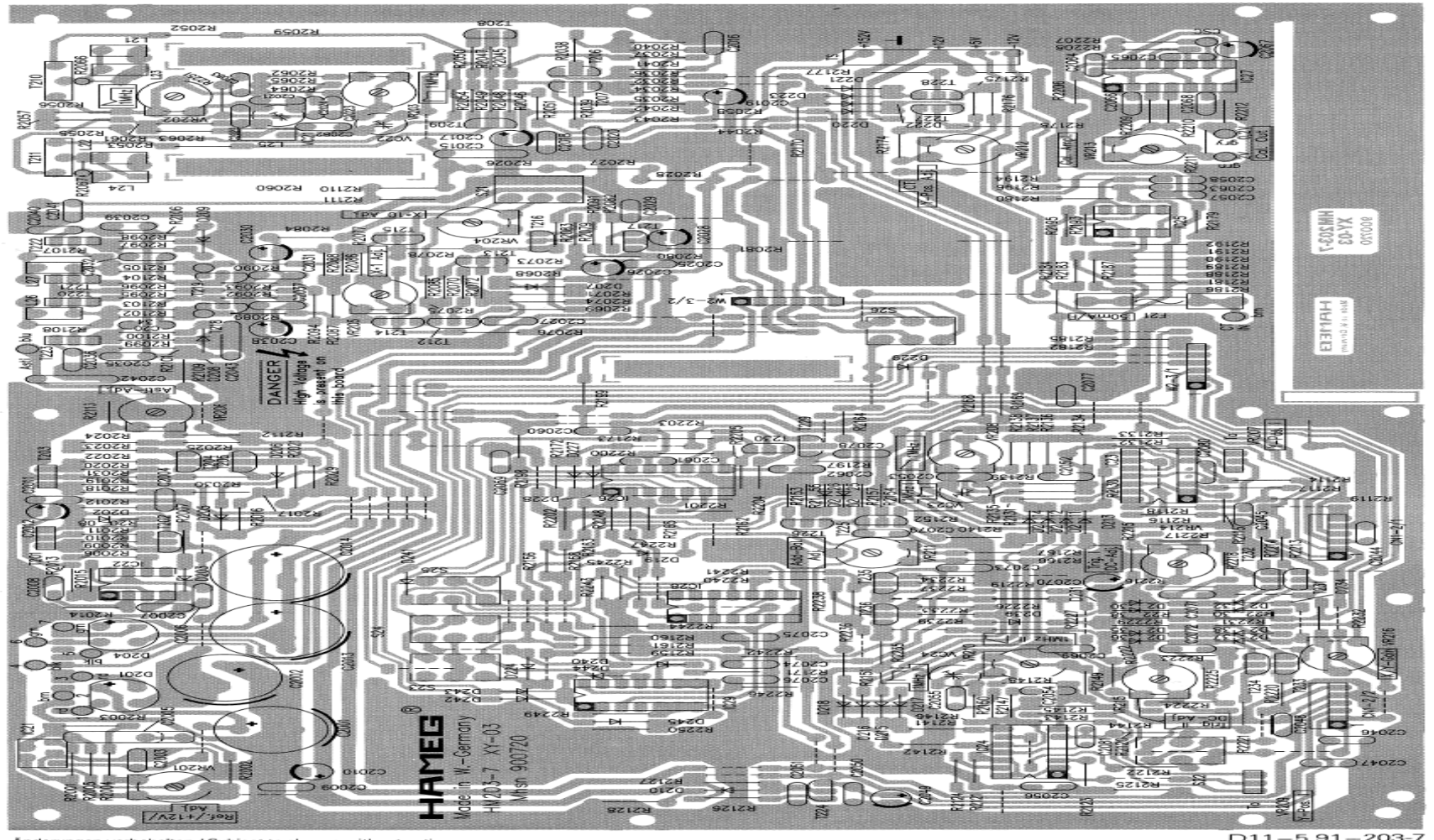




XY-board

Bestückungsplan XY-Board

Component Locations XY Board



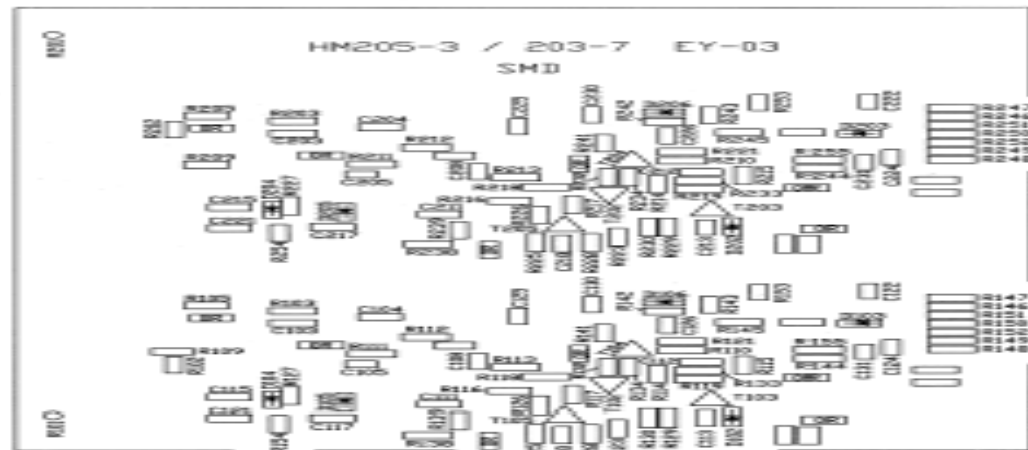
EY board

Bestückerungsplan EY-Board
Component Locations EY Board

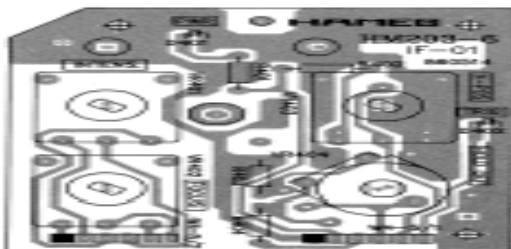
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top

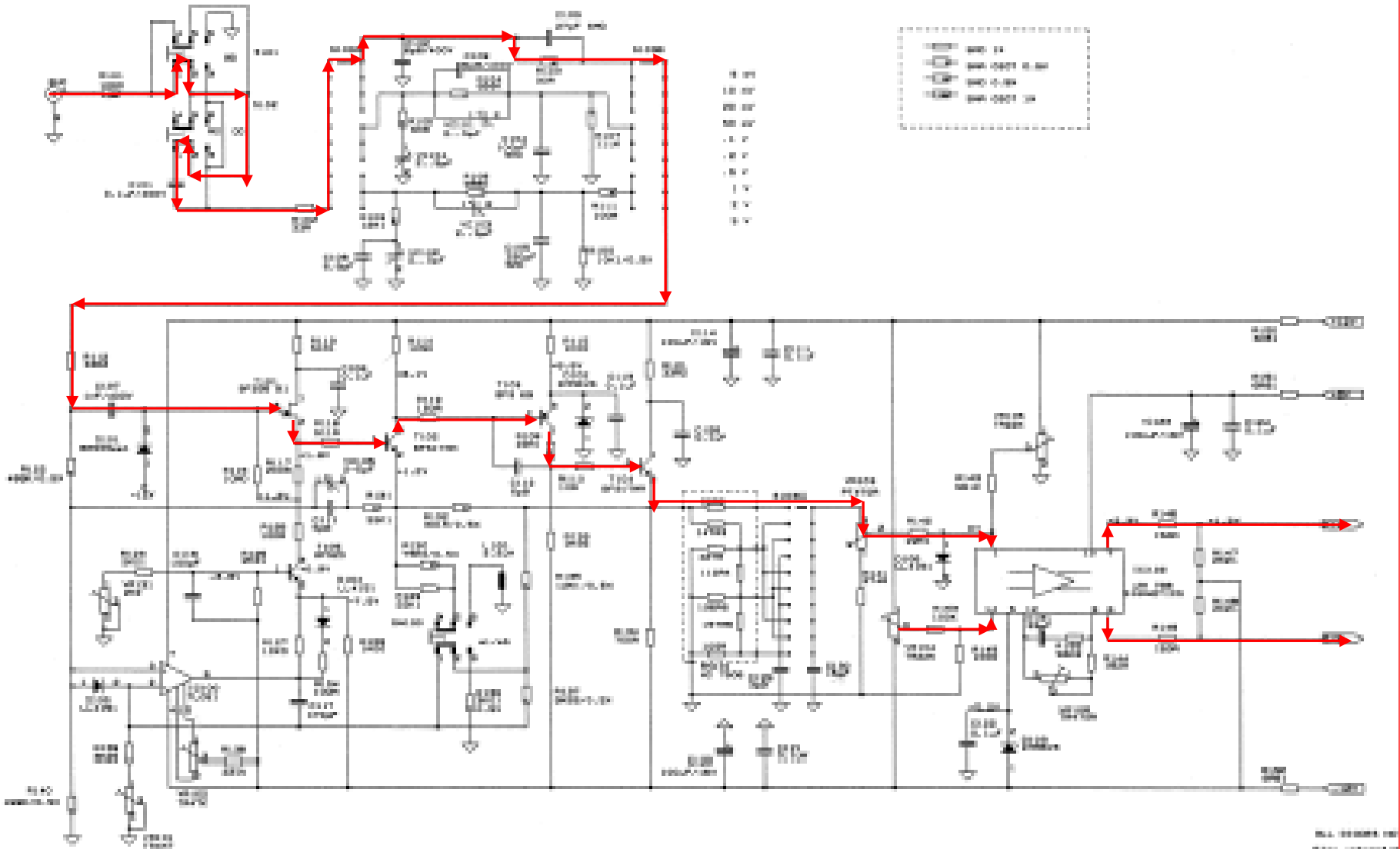


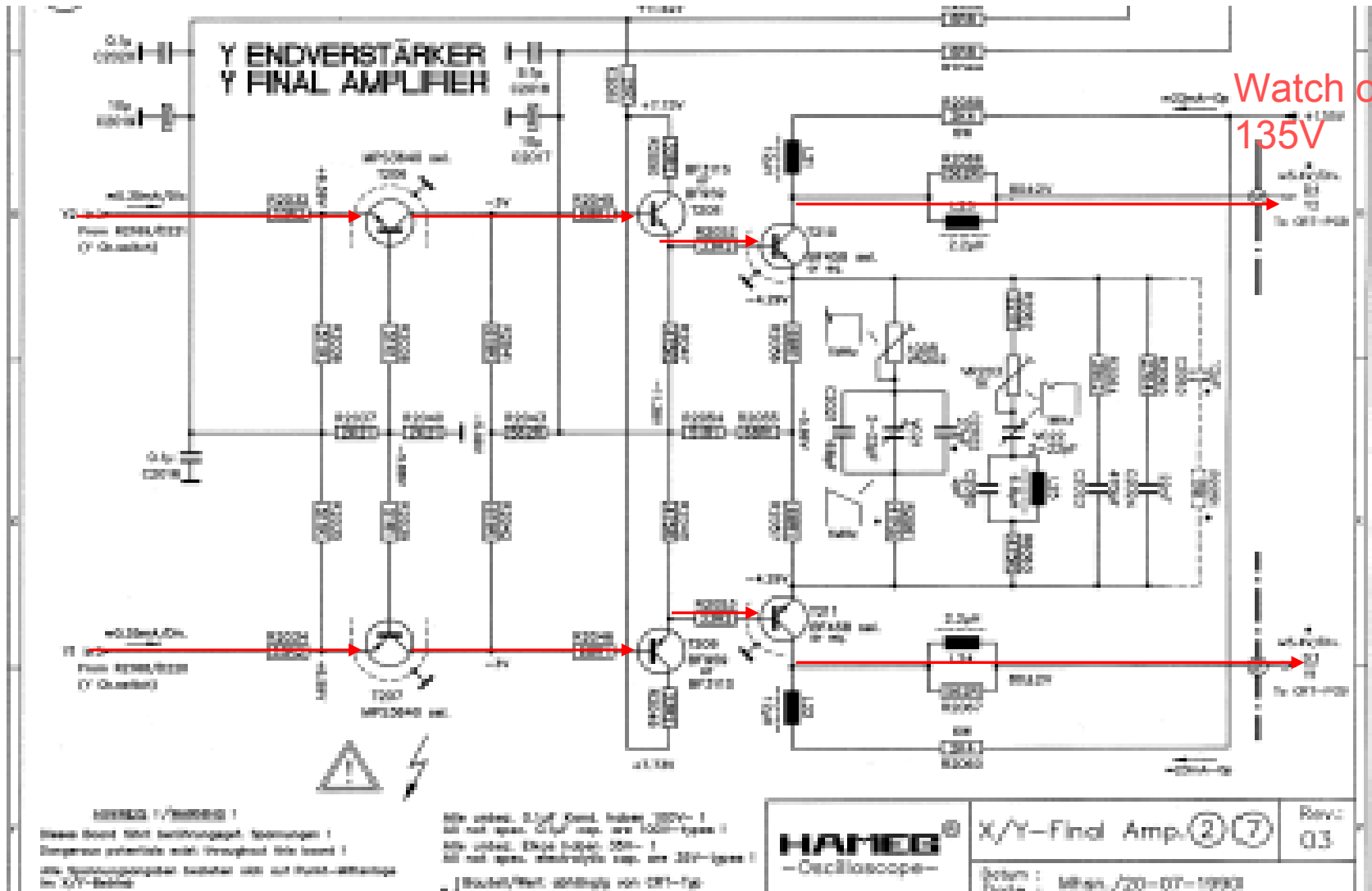
unten
bottom



Bestückerungsplan IF-Board
Component Locations IF Board









Don't mersure her!!

